

# Dynamic Soaring for Persistent Venus Upper Atmosphere Observations, Phase I

Completed Technology Project (2018 - 2019)



## Project Introduction

Although a large majority of the proposed systems for upper atmospheric observation of Venus have consisted of either dirigibles [34,35,36] or solar-powered heavier than air vehicles [9,10,11,12], both suffer from their own particular drawbacks and neither deal effectively with the high wind speeds. This work proposes a solution based on dynamic soaring, a proven method to extract energy from atmospheric shear that has propelled the fastest small-scale aircraft in the world, and provided the energy necessary for long-endurance low-level flights of birds across oceans [13,14,15,16,17]. A deployable unmanned aircraft system (UAS) will be designed to not only survive in the harsh wind environment of Venus, but also simultaneously perform targeted sampling of the atmosphere while continuously extracting energy, even on the dark side of the planet. The design will be based on proven dynamic soaring platforms, but will be constructed in such a manner that allows for deployment from a standard aeroshell. Additionally, an investigation will be performed to select materials and construction methods that ensure long-term survival in the corrosive cloud-top environment.

## Anticipated Benefits

Beyond the obvious NASA application of a mission to Venus there are some other uses of the technologies developed here that will garner interest in other NASA missions. The three main pieces that will have wider interest is the autonomous dynamic soaring, the compact deployable aircraft, and survivability in toxic air. These capabilities will be applicable on Earth for hurricane sampling UAS missions, severe storm sampling, and measurement of volcanic plumes.

Other agencies beyond NASA would greatly benefit from a system that could harvest energy through dynamic soaring and provide lengthy observations above ridge lines and severe convective storms. NOAA would benefit from such a platform for both hurricane observations as well as fire weather observations. The USGS would receive valuable data from a platform able to provide lengthy observations of volcanic emissions. Additionally the NWS could use the platform to feed their ensemble forecasts.



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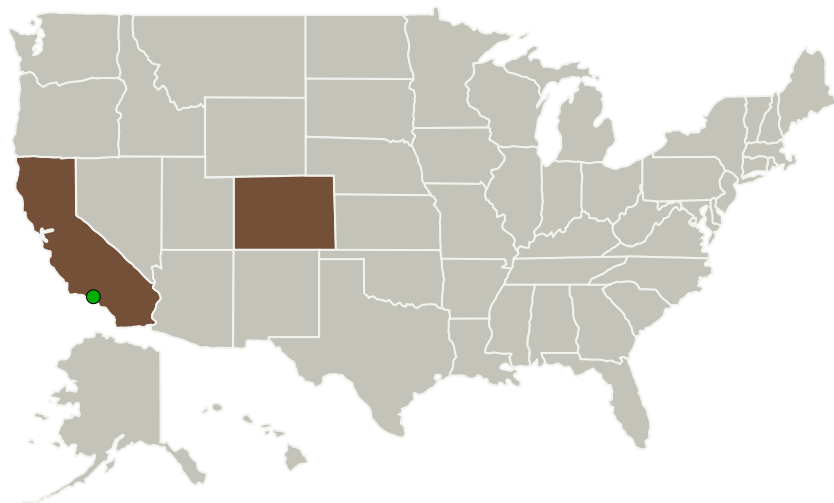
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## Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
Black Swift Technologies, LLC	Lead Organization	Industry	Boulder, Colorado
● Jet Propulsion Laboratory(JPL)	Supporting Organization	NASA Center	Pasadena, California

### Primary U.S. Work Locations

California	Colorado
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## Project Transitions

**July 2018:** Project Start**February 2019:** Closed out

### Closeout Documentation:

- Final Summary Chart(<https://techport.nasa.gov/file/141023>)

## Organizational Responsibility

### Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

### Lead Organization:

Black Swift Technologies, LLC

### Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

## Project Management

### Program Director:

Jason L Kessler

### Program Manager:

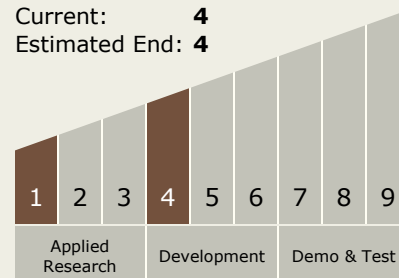
Carlos Torrez

### Principal Investigator:

Jack S Elston

## Technology Maturity (TRL)

Start: **1**  
 Current: **4**  
 Estimated End: **4**

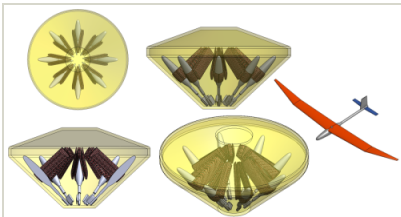


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## Images



### Briefing Chart Image

Dynamic Soaring for Persistent  
Venus Upper Atmosphere  
Observations, Phase I

(<https://techport.nasa.gov/image/134646>)



### Final Summary Chart Image

Dynamic Soaring for Persistent  
Venus Upper Atmosphere  
Observations, Phase I

(<https://techport.nasa.gov/image/134467>)

## Technology Areas

### Primary:

- TX04 Robotic Systems
  - └ TX04.3 Manipulation
    - └ TX04.3.4 Sample Acquisition and Handling

## Target Destination

Others Inside the Solar System